MAY 25 1942

Morris ARBORETUM BULLETIN

JANUARY—MARCH, 1942

Volume 4. Number 1

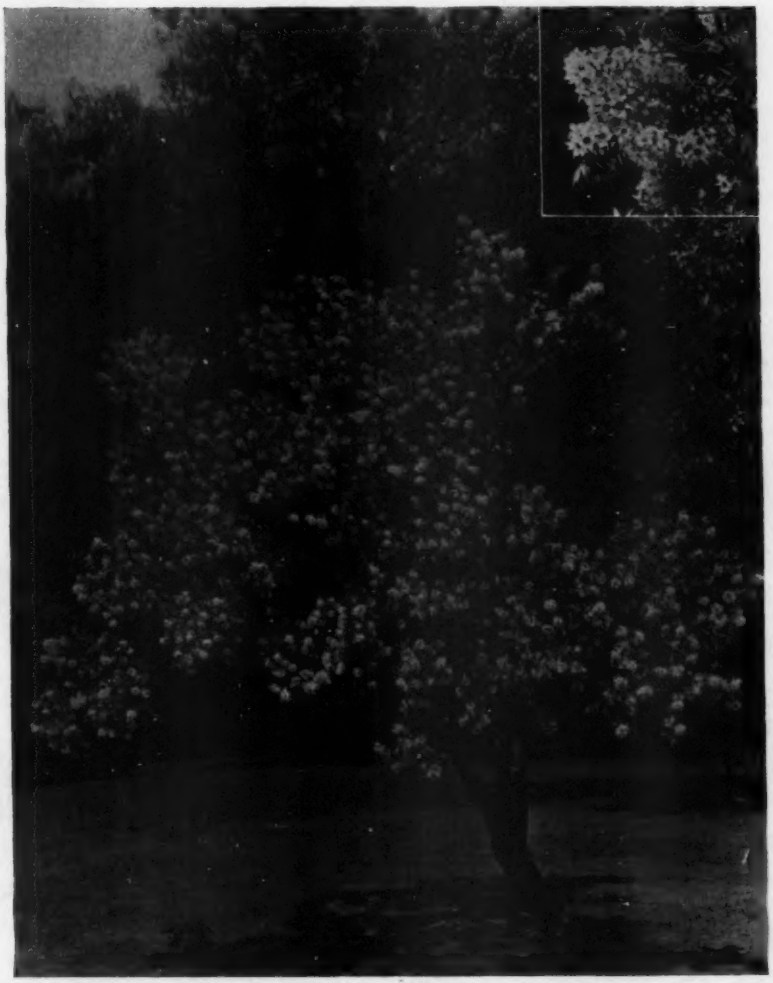

Fig. 1. Yellowhorn
Xanthoceras sorbifolia Bge.

Published by
The ASSOCIATES of
THE MORRIS ARBORETUM
University of Pennsylvania

Trans. to Science 5-10-62

THE MORRIS ARBORETUM OF THE UNIVERSITY OF PENNSYLVANIA

Science Library
QK
479
.P4
A3
V.4-10

MAINTAINED BY

THE MORRIS FOUNDATION

THE MORRIS FOUNDATION
ADVISORY BOARD OF MANAGERS

Thomas S. Gates, *President*

Thomas D. M. Cardeza — Paul H. Musser
John Story Jenks — C. Stevenson Newhall
John F. McCloskey — Wharton Sinkler
Maurice Bower Saul, *Counsel*

THE MORRIS ARBORETUM
ADMINISTRATIVE COMMITTEE

George Wm. McClelland, *Chairman*

John M. Fogg, Jr. — Charles W. Metz
George S. Koyl — Paul H. Musser
J. R. Schramm — Phelps Soule, *Sec.*

J. R. Schramm, *Director* Henry T. Skinner, *Curator*

THE ASSOCIATES OF THE MORRIS ARBORETUM

The ASSOCIATES, through whose interest and generosity this *Bulletin* and certain other undertakings of the Arboretum are made possible, is an informal group of individuals interested in encouraging and furthering the educational and research endeavors of the Morris Arboretum. Further information concerning this organization will be sent on request. Communications should be addressed to The Morris Arboretum, Chestnut Hill, Philadelphia, Pennsylvania.

The Morris Arboretum Bulletin is published quarterly at 111 East Chestnut St., Lancaster, Pa., by the Associates of the Morris Arboretum, Chestnut Hill, Philadelphia, Pa. Application for re-entry as second-class matter at the Post Office at Lancaster, Pa., is pending. Annual subscription $1.00. Single copies 30 cents. Free to Associates of the Arboretum.

XANTHOCERAS — IN MEMORIAM

Almost a year ago a small ten foot tree was just preparing to flower. It was the Yellowhorn, *Xanthoceras sorbifolia,* illustrated on page 1, and one of the most prized and showiest possessions of the Morris Arboretum. The crop of flowers produced in May was good, although scarcely up to standard; but soon after flowering the leaves began to wither, branch by branch, then browned and shortly died. By mid-August nought remained but a memory of former beauty, companioned by a lifeless skeleton awaiting appropriate disposal.

The story is not a new one. Rather, it appears to be the normal mode of exit of a plant possessed of a complete and unvarying abhorrence of old age. This failing of *Xanthoceras* has been observed before both in America and Europe although it has not been recorded perhaps as often as it should; but then, Yellowhorn has always been a rare plant in spite of an introduction from China as early as 1868. W. J. Bean of Kew hints at a coral spot fungus as a possible cause of difficulty, but careful scrutiny of our own late lamented specimen revealed nothing to indicate any form of fungus-caused disease. Xanthoceras is a member of the Soapberry family and is thus a cousin of Koelreuteria, the Varnish Tree. Perhaps the weakness is born of this relationship since Koelreuteria, in age, seems also prone to a rather sudden, branch by branch departure. Koelreuteria, however, has considerably the longer life span and usually gives at least a year or two's warning of an approaching end.

The great beauty of Xanthoceras is seen in May in its quantities of pure white blooms—thickly clustered in abundant short spikes displayed against feathery foliage. Each petal unfolds with a yellow basal blotch which shortly changes to a bright purplish red, and each flower disk bears four horn-like projections from which the plant's name, Xanthoceras or Yellowhorn, has obviously been derived. The pinnate foliage remains a bright, glossy green until killed by frost. Fruits, which are borne quite frequently as the tree approaches maturity, are curious, round, green capsules the size of a small orange—each one hanging heavily from its slender branch, a swaying enticement to squirrels.

In Highland Park, Rochester, a lone, smallish Xanthoceras has the almost amusing habit of bursting into resplendent blossom on Lilac Sunday—that day when splendor by the acre draws milling throngs from far and near. Though the day belongs to the

(*Continued on page 10*)

1903
75 new

FERNS FOR A GARDEN *

Perhaps the first requisite of a garden is *order*. One would not think of planting tall-growing shrubs or trees in a rock garden or narrow border, any more than the reverse—putting nothing but rock plants or low-growing plants in a wide border. We adapt our plants to the space to be planted, and try to achieve a composition with definite order as to size, color and texture, as well as season of bloom.

In ferns, ample material for an ordered planting is at our disposal. We have forms which are tall, medium, or low-growing, of fine or leathery texture, evergreens, or those which are more perishable. By a little thought and care a fern garden or bed can give just as pleasing a composition, with its varying shades of green, as a garden of bright colors. Ferns, moreover, will grow in places where some plants will not—such as in a shady plot of ground or corner where they will do as well as in a small or large woodland, if one is fortunate in possessing the latter. Thus ferns have a strong place in the horticultural world even though they cannot be planted in the perennial border, which requires cultivation and sun, both of which ferns resent. They must not have their roots disturbed and do best with a covering of leaves or humus all through the year. Most varieties prefer a semi-shaded position, and an acid, friable, fairly moist soil. By "moist" soil is meant a well-drained soil, not dry, and yet not one that is constantly wet or marshy.

Ferns should be grouped in sufficient numbers of one species, and placed far enough apart that the beauty of the foliage and luxuriance of the growth can be seen to advantage, and not planted one of a kind, "hit-or-miss." The taller species may occasionally be used as specimens or as accents.

Ferns divide themselves into two classes. In the first are those with slender, branching rootlets at or just below the surface of the soil. These spread rapidly, putting up new fronds all through the growing season, and can be transplanted at any time. They form a dense mat and are more suited to large areas. Under this classification we have *Dennstaedtia punctilobula,* the Hayscented Fern, which prefers a dry, sunny, rocky location. Also of this class are *Dryopteris noveboracensis,* the New York Fern, which prefers a shady, dry place, and *Dryopteris thelypteris,* or Marsh Fern, preferring a moist ground; the last is more adaptable than the first one mentioned, but all three soon take possession of a large area.

Fig. 2. Cinnamon and Ostrich Fern in a Woodland Planting

The second class of ferns, those with thick rootstocks arising from a crown, bear only one set of fronds a season. In planting, the rootstock should be placed upright, with the crown just above the surface of the soil and the roots spread out in their natural position. Most of the ferns best adapted to garden usage come under this classification and a few are listed with their individual preferences:—

Adiantum pedatum, the Maiden Hair Fern, has a fine, light green leaf, dainty in texture, prefers shade, and, as it resents being moved, sometimes makes no growth for a year after transplanting.

The Aspleniums—*Asplenium platyneuron,* the Ebony Spleenwort, and *A. trichomanes,* the Maidenhair Spleenwort, are both low-growing (8-10 inches), suitable for an edging or rock garden and prefer a shady location and lime soil.

Athyrium filix-femina, or Ladyfern, adapts itself to any or every location in sun or shade, has a feathery frond eighteen or more inches long, and is one of the hardiest.

* Editor's Note. — The Morris Arboretum welcomes from one of its Associates this discussion of a plant group whose ornamental possibilities have been rather horticulturally slighted for too long a time. The authority for this article is of the best. Few persons have a better knowledge of the cultivation of hardy ferns than Mrs. Barnes who, at the Arboretum of the Barnes Foundation, has assembled one of the finest fern collections in America.

Cystopteris bulbifera, the Bulbous Bladder Fern, and *C. fragilis,* the Fragile Bladder Fern, are both low-growing (9-12 inches), but the latter dies down in August and leaves a bare place, unless the season is particularly propitious, when it produces a second crop of fronds. *C. bulbifera* not only lasts the entire season, but is not so particular as to location; and, as it reproduces by means of little bulblets on the underside of the rachis and pinnae, as well as by spores, it thrives and spreads profusely.

The Wood Ferns (*Dryopteris*)—all of easy culture—give us a wide choice. *Dryopteris clintoniana,* Clinton's Wood Fern, *D. cristata,* Crested Wood Fern, and *D. bootti,* a cross between the two, are all most attractive and about the same height (18-24 inches), while *D. filix-mas,* the Male Fern, is a little taller and narrower; and *D. goldiana,* Goldie's Wood Fern, is one of our handsomest tall varieties. *D. spinulosa,* Toothed Wood Fern, is again most desirable; and *D. marginalis,* Marginal or Leather Wood Fern, an evergreen with thick, blue green fronds, lends itself to grouping with ferns of a lighter green color and texture. *D. viridescens,* Glossy Wood Fern, is the daintiest and most attractive of all, but unfortunately not listed by many dealers.

FIG. 3. *Dryopteris viridescens* is daintiest and most attractive of the Wood Ferns.

Onoclea sensibilis, the Sensitive Fern, is of a rather coarse texture and frond, but will grow in poor soil, and, although it will spread rapidly, it fills a need. In winter, moreover, its dried sporophylls are not unattractive.

We have the Cliff Brakes—*Pellaea atropurpurea* and *P. glabella,* both of which, as their name implies, love to grow in cracks of cliffs, preferably limestone.

Polypodium virginianum is an evergreen, low-growing fern, delighting to grow on rocks or fallen logs in moist, shady places.

The best known, perhaps, of our evergreen ferns is *Polystichum acrostichoides,* the Christmas Fern, of a dark green color and a rather thick texture, which we see on steep north banks of our country roads—its preferred situation in a well-drained soil. *Polystichum brauni,* Braun's Holly Fern, is not quite evergreen; its heavy and rather hairy 18 to 20 inch fronds inevitably bend down in late Autumn. It prefers semi-shade and rather moist soil.

Pteretis nodulosa, the Ostrich Fern, which, with its 5 to 6 feet, is perhaps the tallest of our natives, is also one of the first to appear in the Spring. It dies down, however, in early August, leaving brown, bare stalks and also has the bad feature of spreading by adventitious buds on the rootstock.

The Woodsias—*Woodsia ilvensis* and *W. obtusa*—are both desirable low-growing, 8-10-inch ferns preferring cliffs as a natural habitat. But Woodsias are rather difficult to transplant, as also are the Woodwardias or Chain Ferns—*Woodwardia areolata* and *W. virginiana.*

Last, but not least, are the ever popular Osmundae—*Osmunda cinnamomea,* the Cinnamon Fern, *O. claytoniana,* the Interrupted Fern, and *O. regalis,* the Regal Fern, which three are all of easy culture, tall (18-24 inches) and grow in either sun or shade.

This, of course, is not a full list or description of all the many ferns now on the market (it is always best to buy from a nurseryman, rather than to rob our countryside), but I have tried to show that by choosing ferns of the correct height, texture and shade, a garden to give pleasure in all seasons of the year may be made. If bright color is deemed necessary, many of our native wild-flowers will thrive under the same conditions as ferns and bring an added touch of interest to the picture.

LAURA L. BARNES, *Director,*
Arboretum of the Barnes Foundation

LECTURE TOURS AT THE ARBORETUM

As a result of the success of this feature last year, the following outdoor "discussion" tours have been scheduled for the 1942 season:

May 9, 2:00 P. M.

THE ROCK WALL

Leader: ARCHIE THORNTON, Rock plant Specialist of Poughkeepsie, N. Y.

As author of the Rock Garden Primer and a frequent contributor to horticultural literature, Mr. Thornton's name is familiar to all admirers of Rock and Alpine plants. On this date the rock wall at the Arboretum should be at its best. Discussion will center on wall plants as well as problems of maintenance. This lecture commences one half hour earlier than usual to permit those visitors who so desire to attend the University May Day pageant being held near the Germantown Gate at 3:00 P. M.

May 30, 2:30 P. M.

EASTERN ASIATICS IN EASTERN AMERICAN GARDENS

Leader: J. M. FOGG, JR., Dean of the College and Associate Professor of Botany, University of Pennsylvania.

Dr. Fogg needs no introduction to a Philadelphia audience of either horticulturists or botanists. Although perhaps best known for his extensive studies of our native flora, Dr. Fogg has always had an especial interest in the numerous similarities between oriental and eastern American plants. He will have interesting facts about many of our finest ornamentals.

June 6, 2:30 P. M.

ESTABLISHMENT AND CARE OF LAWNS

Leader: WALTER LAPP, Specialist in Lawn Care, Lansdale, Pa.

Mr. Lapp is well equipped to provide the kind of information most needed upon all kinds of lawn problems. There will be opportunity to visit Mr. Lapp's lawn test plots at the Arboretum, where various points regarding grass establishment, as well as fertilizer and weed treatments can best be demonstrated.

September 26, 2:30 P. M.

POISONOUS PLANTS OF FARM AND GARDEN

Leader: D. WALTER STECKBECK, Associate Professor of Botany, University of Pennsylvania.

Dr. Steckbeck has studied poisonous plants in various regions of the United States and is in charge of the work in Veterinary Botany at the University of Pennsylvania. Special attention will be given to poisonous and near poisonous plants of the Pennsylvania countryside with some reference to exotics and to plants yielding drugs.

October 10, 2:30 P. M.

MAN AND NUT TREES

Leader: J. RUSSELL SMITH, Swarthmore, Pa. Emeritus Professor of Economic Geography, Columbia University.

No one has contributed more to the field of Economic Geography than Dr. J. Russell Smith. He is president of the Association of American Geographers as well as author of various texts and articles in this field, including a book, *Tree Crops a Permanent Culture*. A world traveller, Dr. Smith has studied tree crops and their potentialities for permanent land improvement in many climates besides our own. He will have food for thought as well as first hand and practical information on nut varieties.

Anyone is welcome and is cordially invited to attend the above lectures, which occur at times when plants at the Arboretum are of maximum interest. There is no charge. Visitors are encouraged to bring along their problems.

All tours, unless otherwise stated, commence at 2:30 P. M. on Saturdays at the Administration Building and will last from one to two hours. In case of wet weather individual meetings will be automatically postponed one week. In this likelihood, confirmation can be secured by telephoning Chestnut Hill 5232.

THE WALL GARDEN

Most popular spring feature at the Morris Arboretum is the six-foot rock wall which surrounds the rose garden upon three sides. As a reminder to those who may be planning a visit in the near future, the rock wall is now at just about its best and will continue in abundant color into early May.

Regular visitors may observe a few changes this year which we hope are also improvements. The wall has always been well clothed with flower

FIG. 4. The Arboretum Rock Wall at the height of the color season in early May.

but, with so many large clumps of candytuft, alyssum and moss pink, colors have not been too varied or of maximum interest. The flower season, moreover, has been short. Towards improving this situation a weeding and replacement process has been undertaken which has included the addition of some seventy new species and varieties of plants, selected upon a basis of their color, season of bloom and general suitability for wall usage. Alyssum, for instance, is now represented by four varieties rather than one, campanulas by at least seven, silenes by four and phlox and dianthus by numerous forms, in addition to very many genera of which there were formerly no representatives at all. Although these additions will be more conspicuous next year, a fair number can certainly be looked for this season.

As quickly as possible, a majority of plants of each variety is being provided with stainless steel identification labels, and commercial sources for the purchase of any plant in the collection will be available upon request to persons interested. It is hoped that this example of a rock wall which demonstrates the use of some of the best low-growing wall plants may thus amply justify its existence as an educational feature as well as one which, for many years, has been unquestionably decorative.

TEN THOUSAND POUNDS OF BEEF

A strange topic from a botanical institution, it would seem; yet not so strange—in fact, appropriate and timely. The Arboretum area still awaiting development includes some fifty acres of good grassland. From April 29 to December 6, 1941, forty-five head of two-year-old beef cattle grazed this area continuously and, without any supplementary feeding, showed at the end of the season an aggregate gain in weight of about ten thousand pounds—five tons of quality beef on the hoof added to the food reservoir of the United Nations.

That growing farm animals consuming plants or plant products as feed convert a part of the ration into additional muscle, bone, fat, etc., ordinarily does not arouse our curiosity or wonderment because it is commonplace and universal. But when the question is asked, where do the plants get the foods which man and animals appropriate to build their bodies and furnish energy for their work, many of us will be perplexed and at a loss for a satisfying answer. Actually, what happened on the Arboretum acres involves the most basic and universal of physiological processes.

The nature of these processes can best be illustrated by a simple experiment. Most of us perform similar experiments in our garden and farm operations without perhaps being aware of it or fully appreciating the implications. Five grains of corn (maize) are planted in pure quartz sand and spaced to permit full development. They are kept supplied with water in which are dissolved small amounts, in some cases bare traces, of some six or eight mineral salts. Beyond this, merely a favorable growing temperature, sunlight, and air are provided. With crows, cutworms, and squirrels exercising proper restraint, the grains germinate and seedlings emerge, growing into plants which flower and in turn bear seeds. Assuming that each plant bears two ears, the yield of grain will be sufficient for a generous family meal of nutritious corn bread. In addition, there are the dry leaves, shucks, and tassels as palatable stock feed, still leaving substantial amounts of organic matter in the form of stalks and roots. And we started with five grains of corn!

Before attempting to interpret the experiment, it may be instructive to ponder the probable performance of one of the steers subjected to the same experiment. In attempting to subsist and grow on the diet of water and a few mineral salts, while basking in the warm sunshine and breathing pure country air, the steer will, we fear, have the experience of the Missouri mule whose master attempted to teach him how to get along without feed. Just as he had about learned it he up and died. Why this amazing difference between animals and green plants? The answer involves one of the most fundamental processes in all nature, and leads us back to a closer examination of our corn experiment.

Obviously the corn plants did not have available in their environment any of the substances which we commonly think of as foods—carbohydrates, fats, proteins, etc. (the small amounts of these substances present in the seeds planted were soon used up in the early stages of development). And yet the harvest of corn grains contains these in abundance, as do in varying degree the other parts of the plants. Where did the plants get them?

The answer is, they made them—out of the simple inorganic materials available to them. It is precisely this that animals are unable to do and that makes them all, including man, directly or indirectly dependent upon plants. Granted that some animals live entirely on others and these in turn on others, sooner or later in this chain we come invariably to a link where the dependence is on plants. Green plants are in fact a sine qua non of animal existence.

Chemical analysis reveals that plants are composed of a great array of organic compounds, in which carbohydrates, and to a lesser extent proteins and fats, usually predominate. All these substances contain the element carbon (so common in coal) in combined form. Besides carbon some ten or a dozen other chemical elements are represented in appreciable amounts. But for our present purpose it will be well to keep attention fixed on carbon. Where does the plant get this indispensable component, which accounts for roughly fifty per cent of the dry weight of plants?

For a time it was believed that the " humus " of the soil was the source. This possibility is excluded in our simple experiment because the usual soil was replaced by pure quartz sand (composed only of silicon and oxygen). Rapid advances in chemistry beginning in the latter half of the eighteenth century made it possible to prove at the turn of that century that the *air,* not the soil, is the source of the carbon. This at first seemed incredible for in ordinary air the only carbon is that in the gas carbon dioxide, which makes up but three-hundredths of one per cent of the air by volume. But a firmly established fact it is. We come then to the astounding fact that the colossal amounts of carbon which green plants build into their bodies are extracted from the minute quantities of carbon dioxide in the atmosphere, a substance which, together with water, represents the chief waste product in animal respiration and in fuel combustion.

The green plant thus covers its carbon requirements from the very substance which the animal casts out as completely oxidized (having had all the available energy extracted) and which it is unable to utilize as a carbon source for its nutritional requirements. In this fact we discern the bold outlines of a profound difference between animals and green plants and the reason why the former could not exist without the latter. What is responsible for this fundamental distinction between the corn plants, which get along with only carbon dioxide as a source of carbon, and the steers, which require as a source of carbon such energy-loaded and highly synthesized compounds as the carbohydrates, proteins, fats, etc., acquired in munching the Arboretum grass?

The answer is *photosynthesis.* Since this is probably the most fundamental of all biological processes, it merits examination. Its general nature is disclosed by its name—synthesis implemented by light.

It is common knowledge that the bodies of plants, like those of animals, are subdivided into microscopic coordinated and interdependent units term " cells." The living active stuff—protoplasm —in these cells contains numerous microscopic disc-shaped protoplasmic bodies termed *plastids.* When these plastid-containing cells are exposed to light, a complex organic green pigment—*chlorophyll*—is produced, rendering the plastids bright green. It is this process which is responsible for the prompt greening of the emergent portion of seedlings while that below ground remains blanched. It is seen again in the rapid greening of dark-developed sprouts of seeds, bulbs, tubers, etc., when brought into the light. We come thus to the broad generalization that it is these myriads of chlorophyll-containing plastids (*chloroplasts*) imbedded in the protoplasm that render leaves and other plant parts green.

In the absence of definite knowledge, man was prone to view this prevailing dress of green as donned for his special delight—restful and beautiful to behold, which assuredly it is. Alas, man's egocentric proclivities here, as often in other matters, led him to overlook what the green might mean to its possessors. As is now known, its significance is fundamental. Though our readiness with anthropomorphic interpretations has received a healthy jolt, understanding and something akin to respect has been added to our undiminished love of and delight in the green of plants.

These chloroplasts turn out to be the myriad amazing laboratories in which, and in which alone, the plant brings the carbon of atmospheric carbon dioxide back into the organic cycle by means of a unique synthesis. More specifically, in these green plastids, with sunlight as the source of energy, the components of carbon dioxide and water are chemically rearranged and combined in such a way as to produce, probably after several intermediate steps, a soluble sugar (carbohy-

drate); and in the process oxygen is released. The precise course of this synthesis is not known. Certain it is, however, that within the chloroplasts when exposed to sufficient light, carbohydrates are easily detectable within a short time after illumination starts. And the amount increases with time, so that during a sunny summer day the plastids become literally gorged with carbohydrate.

Too much emphasis can scarcely be placed on the cosmic significance of the phenomenon here sketchily described—carbon dioxide and water synthesized into carbohydrate in the plastids, with the indispensable participation in some way of the chlorophyll and with sunlight furnishing the energy necessary to do the work. In a certain sense carbon dioxide and water are the very "foods" the plant uses in the process. And to this extent, since oxygen is *released* as a waste product in this synthesis, photosynthesis is the exact reverse of those metabolic processes in animals in which sugars, by the *addition* of oxygen, are completely oxidized ("burned") to carbon dioxide and water, yielding up *all* their stored chemical energy for the animals' use.

It was remarked above that sunlight furnishes the energy to do the work in photosynthesis. A sugar like glucose, which is a common ultimate product of photosynthesis, gives no external evidence of being charged with energy. But if it is ignited it burns, liberating intense heat (a pound of glucose completely burned to carbon dioxide and water will raise the temperature of four and one half gallons of water from the freezing to the boiling point). This heat is obviously an *active* perceptible form of energy that can be made to do work, e. g., drive a steam engine. But where does the heat come from when glucose is burned? The answer is, from the *latent* energy in the glucose, a form of energy termed chemical energy and which obviously is not perceptible in the sugar as such.

In pursuing this energy trail, we must pose one more question: Where does the sugar produced in photosynthesis from carbon dioxide and water get the energy which is stored in its molecules as chemical energy? Here the answer is *sunlight*. Active light energy is thus converted into an equivalent amount of latent chemical energy locked up in the glucose produced as a result of photosynthesis. Light, then, is the ultimate source of all energy in living organisms. And since coal and petroleum are the unoxidized carbon remains of once living organisms, these enormous stores of energy also derive from sunlight converted into latent chemical energy in past geological ages through the instrumentality of photosynthesis.

Against the background of this transcendent importance of sunlight and photosynthesis in the maintenance of all life, we return to our Arboretum acres. Between April 26 and December 5, 1941, the fifty grassy acres received a total amount of light energy equivalent to the heat energy obtained by the complete combustion of 24,396 tons of high quality anthracite coal, or 488 tons per acre.[1] If even most of this lavish supply of energy were used in photosynthesis and locked up as chemical energy in the organic substances produced, we would indeed have a bonanza of available energy and organic materials. Were this the case it would allay the growing concern of mankind as the exhaustion of the supposedly endless stores of energy in coal and petroleum looms as a specter on the horizon. Though intensive use of coal covers only somewhat more than a century and that of oil less than half that period, the end is in sight, whether the calculations of experts be gloomy or rosy. Literally, the colossal reservoirs of energy in the form of unoxidized remains of carbon compounds built up over the geological eons, directly or indirectly through photosynthesis, are being squandered in a gigantic spree—the industrial age—, and never before so recklessly as today. And the inevitable ensuing migraine of this brief, geologically speaking, exhilarating moment is already palpably evident.

Alas, at best photosynthesis utilizes but a small fraction of the light energy available (or shall we say alas, for man's use of unlimited accessory physical power has not been too reassuring to date). No measurements have been made on the Arboretum area. Such data as are available for certain crops and types of vegetation in other regions and latitudes make it doubtful that the grass on the fifty acres used in photosynthesis over one per cent of the available energy. Much of the

[1] Solar radiation records for the Philadelphia area are not available; but for Washington, D. C., continuous observations have been made since 1914, and for New York City since 1924. Since total radiation varies with latitude, and since Philadelphia latitudinally is not far from midway between these two observation points, the above calculations represent the mean of the Washington and New York data (taken from HAND, IRVING F. Review of United States Weather Bureau solar radiation investigations. *Monthly Weather Review*, Vol. 65: pages 415-441. 1937).

light is reflected into space from the plants and the soil; other substantial quantities not intercepted by the plants are absorbed by the soil; and in other ways the efficiency of the photosynthetic utilization of the available light is limited.

But inefficient as it may appear to be, photosynthesis is still the only effective process for employing light in the synthesis of organic life-sustaining products and trapping and storing light energy as latent chemical energy in the substances synthesized. Aside from minor human devices designed to utilize light energy, such as heating water or propelling "sun motors," science and technology have not to date succeeded in effectively harnessing light energy. Perhaps this is because they have not as yet wrested from the tiny living chloroplast its full cosmic secret.

This is not the place to attempt to trace in detail the fate of the grass munched by the steers. Suffice it to recall that much of the organic material (food) is used up to furnish energy to maintain body temperature and activity; indigestible or unused portions are lost as wastes; etc. Thus, only a minor fraction of the latent chemical energy in the grass finally turns up in the substance of added muscle, fat, etc., i. e., as gain in weight. And, though impressive, the 10,000 pounds of beef produced represent, in terms of latent energy content, not only an extremely small fraction of the light energy available on the fifty acres, but also only a minor part of that bound by photosynthesis in the grass consumed.

We may call this inefficient if we like; but it is the economy nature has evolved, based on the utilization of light energy by green plants through photosynthesis. And man to date has devised no practical substitute for it. And so it is that green areas,[1] whether occupied by crop plants, grass, or forest, are the sole ultimate source of food, whether plant or animal, and of life-sustaining energy. The Arboretum acres are enlisted for the duration.

J. R. SCHRAMM

[1] In the oceans and fresh waters, with their teeming life yielding much food for man and animals, the principle is identical. It would take us too far to explore this fascinating field here.

Xanthoceras — In Memoriam

(*Continued from page 2*)

lilac, yet it is in front of Xanthoceras more than any other one plant that the family line keeps forming and the Kodaks click. It's away in a corner; it's small, but it steals the show.

Propagation of Xanthoceras is usually by seeds or root cuttings. Seeds, stratified or held cool over winter, will germinate quite readily in the spring. The resultant seedlings, however, are peculiar in that 30 or 40 percent are frequently albinos which attain a height of an inch or two but, totally lacking in chlorophyll, are able to make no further growth when the food contained in the rather large seed has become exhausted.

The ability of roots to produce new individuals is now being well demonstrated at the Arboretum. The specimen, prior to demise, never showed much tendency to sucker. Before fall however, last year, a fair scattering of young shoots appeared several feet from the original trunk—obviously from roots which had remained alive even though the top had long since ceased to function. It is to be hoped that these suckers may provide for us the start of another generation of this, one of the loveliest of all small trees.

HENRY T. SKINNER

NOTES FROM THE LABORATORY

Locust Leaf-Miner on Pagoda-Tree

Last year (1941) during the extremely heavy infestation of black locust trees with the locust leaf-miner, *Chalepus dorsalis*, the same insect was also found to be infesting *Sophora japonica*, the Japanese Pagoda-Tree. Mining of about five to ten per cent of the leaves was noted in late June and emergence of the adult beetles from July second to the tenth.

While control is possible by an arsenate of lead spray in April, it is not considered a necessary precaution in this instance in view of the light infestation of the newly observed host in a summer which saw black locust trees practically one hundred per cent invaded.

This report is made not because of the importance of the outbreak but rather because it is the first time that this insect-host relationship has come to our attention.

SPENCER H. DAVIS, JR.

An Effective Control for Leaf Blight of English Hawthorn

A pink-flowered English hawthorn, *Crataegus oxycantha rosea-plena,* growing just inside the main entrance to the Morris Arboretum, has been heavily attacked by the leaf blight disease (*Entomosporium theumenii*) for a number of years. This organism has caused an annual defoliation of all of this species of Crataegus in the vicinity, the trees becoming leafless before the first of September.

Last summer a spray schedule was followed which consisted of Bordeaux 4-4-50 at bud break (April 16) and again on April 22 and 30. On the first of October the tree was still bearing good foliage, although somewhat leaf-spotted, in contrast to the almost leafless trees of this species in the neighborhood of the Arboretum. (figs. 5 and 6).

The photographs, taken October the first, show the foliage carried by the sprayed tree, and the condition of an unsprayed tree on a nearby estate. On the unsprayed trees the small covering of leaves is not of the original spring break but those of a second crop which appeared later in the summer following the complete defoliation by mid-August. Concurrent with the scanty new crop of leaves were also a few flower-clusters, an entirely abnormal condition resulting from the extreme defoliation.

FIG. 5. Looking up through foliage of sprayed tree.

FIG. 6. Looking up through foliage of unsprayed trees.

SPENCER H. DAVIS, JR.